



U.S. Fish and Wildlife Service

Humboldt Bay National Wildlife Refuge
Humboldt County, California

Ma-le'l Dunes Restoration Summary and Photodocumentation



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Updated June 2014

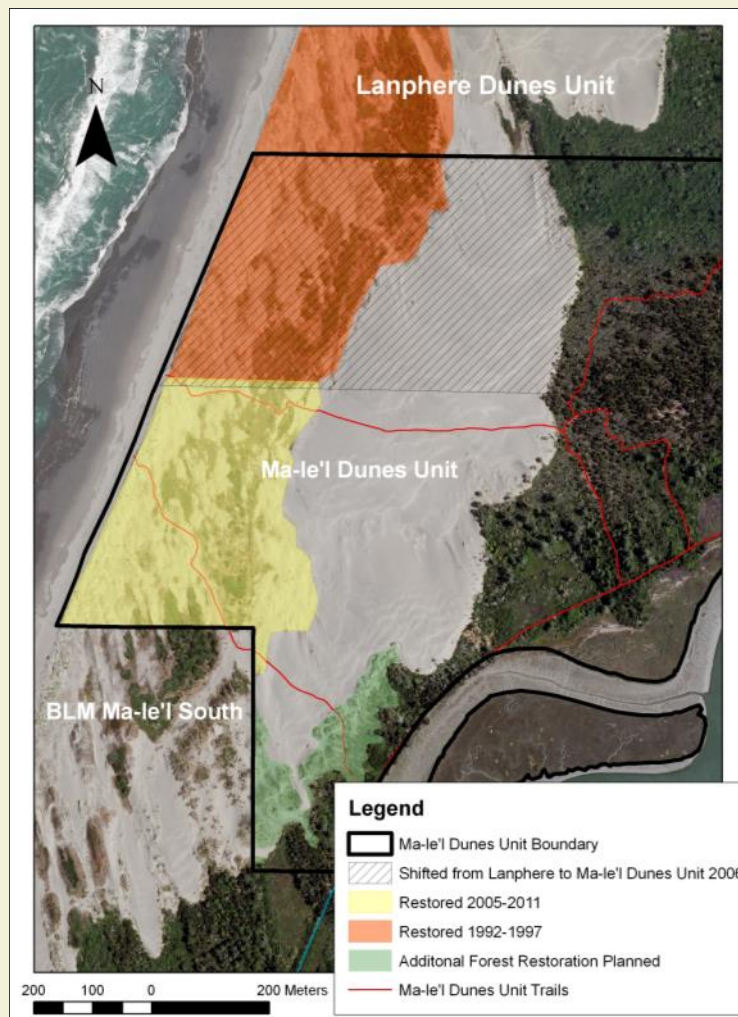
Humboldt Bay National Wildlife Refuge
6800 Lanphere Rd.
Arcata, CA 95521

Introduction

The Ma-le'i Dunes Unit of Humboldt Bay National Wildlife Refuge consists of two parcels with different restoration histories. The northern 100 acres of land were purchased when the Lanphere Dunes were still owned and managed by The Nature Conservancy. This northern parcel was restored concurrent with the rest of the Lanphere Dunes Unit between 1992 and 1997 (for information and photographic time series on that project see separate report). The southern 160 acres was acquired by the U.S. Fish and Wildlife Service in 2005. Between 2005 and 2011 European beachgrass, yellow bush lupine, pampas grass, iceplant, and other invasive plants were removed from the foredune zone and deflation plain of the site. English ivy, cotoneaster, English holly and other forest invasives were cleared from the forest. Native dunegrass was planted along the foredune in 2009 through 2011.

Major restoration activities were completed in 2011. Follow-up is ongoing to remove any remaining resprouting or newly dispersed beachgrass and iceplant as well as recruits of annual grasses and yellow bush lupine from the seedbank.

The photographic time series presented here illustrates the results of restoration to date, with a discussion for each area of the dunes.



Foredune Zone

The foredune is usually the most altered dune feature when invasive plants colonize the dunes. European beachgrass is very effective at trapping sand, and generally prevents further movement of sand beyond the foredune. When a European beachgrass-dominated foredune is restored, sand moves inland both by travelling up to and over the crest of the foredune, and through the formation of blowouts. Vegetation shifts to a far greater diversity of species, often including the native dunegrass *Elymus mollis*. *Elymus* was planted in a number of places on the foredune during the restoration process, and has greatly expanded. Immediately after restoration, there are more areas of open, blowing sand. Over time, these become more vegetated. This process can be seen occurring in the photographs presented here.

In the past four years an incipient foredune (a lower ridge in front of the foredune) has developed along much of the upper North Spit. The incipient foredune in restored areas tends to be dominated by native dune grass and other pioneering species such as yellow sand-verbena, whereas in invaded areas the incipient foredune is covered with European beachgrass. Incipient dunes are usually ephemeral in our dune system, coming and going cyclically in response to changes in storm patterns (such as El Niño cycles) and/or sediment availability. However, both in native and invaded systems, incipient foredunes may build into established foredunes and persist for longer periods of time.



The established foredune (foreground) with beach buckwheat, beach bur, beach strawberry and other species. An incipient foredune (background) is vegetated primarily with native dunegrass.

Blowouts are a natural feature of our dune system. Blowouts evolve into long, narrow “parabolic” dunes, which migrate inland, leaving vegetated “trailing ridges” in their wake until their advancing front becomes stabilized by vegetation. Over time, these trailing ridges have formed the characteristic “ridge and trough” topography seen at the adjacent Lanphere Dunes. The Ma-le’l foredune was completely flattened as the result of a major erosional event that occurred before 1939. To the north (the Lanphere Unit), where there was more relict topography and native vegetation, a native foredune was rebuilt. However, at Ma-le’l there was much less relict topography and vegetation, so when European beachgrass spread into the Ma-le’l area in the 1970s it became the dominant species. In addition to building a foredune, it prevented sand movement inland. As a result, the topography at Ma-le’l has fewer old parabolic dunes and is generally lower than at Lanphere. This effect is compounded by the presence of a south-north natural gradient of dune elevation on the North Spit.

Removal of European beachgrass increases the likelihood of blowouts forming. Planting with native dunegrass can help re-establish a balance between foredune stability and blowouts. Currently, there are very few blowouts at Ma-le’l that are actively being fed from the beach. The incipient foredune has closed the “mouths” of the blowouts, which are becoming vegetated. This process has been accelerated by the planting of native dune grass along the foredune.



A stabilizing blowout in the foredune. The incipient dune (background) is now slowing the acceleration of wind into the blowout, which is becoming vegetated with native dunegrass and other species.

2005



2011



2014



After beachgrass was removed in 2005, several erosional events caused foredune scapring. Sand on the foredune began moving and by 2011 the foredune crest was lower. But by 2014 native vegetation was trapping new sand,. Portions of the foredune visibly increased in elevation over the 3-year period 2011-2014.

2005



2011



2014



This photo series also demonstrates changes in the foredune after restoration and storm events. The foredune crest was lowered, followed by accretion (a rise in elevation from sand deposition) as vegetation cover increases. The most elevation gain has occurred in the area where native dunegrass has increased.

2005



2011



2014



Again, this series of photos illustrates both foredune elevation gain and cover increase. Between 2011 and 2014, the foredune crest in the middle ground of the photograph has increased in height such it obscures the foredune in the distance. Native cover increased dramatically between 2011 and 2014.

Narrow Parabolic Dunes

The dune ridges that run parallel to predominant wind direction (NW-SE) behind the foredune are formed when blowouts in the foredune create narrow parabolic dunes that move inland over the pre-existing topography. Sometimes these ridges move over low-lying wetlands, their trailing ridges creating “ridge and trough” topography of alternating ridges and valleys. Before restoration of the Ma-le’l Dunes, some relict trailing dunes were present and supported native dune mat, although these areas were rapidly being invaded. Restoration of these areas involved the removal of European beachgrass, yellow bush lupine, iceplant, and exotic annual grasses such as ripgut brome. These ridges are more protected from salt spray and wind than the foredune, and they provide prime habitat for the endangered Menzies’ wallflower and beach layia.



The pattern of parallel trailing ridges can be seen in this photo of restored dunes at Ma-le’l. The intervening bands of green are wetland “slacks” or “swales” vegetated with willows and rushes; they formed as the centerline of the parabolic dunes (the area between the trailing ridges) eroded down to the water table.

2005



2011



2014



The trailing ridges in the center of the photograph had been invaded by European beachgrass and ice-plant, creating continuous, dense cover. The native dune plants, including those endangered, rely on openings and disturbance to thrive.

2005



2011



2014



A trailing ridge that eroded into distinct hummocks was covered with European beachgrass in the middle ground (top photo). Restoration also involved removal of shrubs of coyote brush, native to coastal bluff scrub but not a member of the dune mat community. The dark areas on the rear hummock (top photo) were patches of dead iceplant.

Deflation Plain and Seasonal Wetlands

To the east of the foredune zone is an expansive, relatively flat area formed at the trailing edge of the large transgressive dunefield to the east. The base of the transgressive dune field is lowered as the sand moves east, until the surface reaches the summer water table. The moisture prevents additional deflation, and nourishes many species of seasonal wetland species. In winter, the reversal of prevailing winds can blow sand back into the deflation plain, causing localized topography. In particular, a small ridge (known as a gegenvalle ridge) often forms at the east end of the deflation plain during the winter. These upland areas are targets for invasion by European beachgrass and yellow bush lupine. Many of the Ma-le'l seasonal wetlands consisted of dense stands of intermixed bush lupine, coyote brush, and pampas (jubata) grass. Restoration here focused on the removal of invasives including annual grasses, but also involved scraping away the layer of "duff" that had accumulated as the result of the presence of large, short-lived, nitrogen-fixing bush lupine. The presence of the duff impedes the return of native species adapted to low nutrient conditions and can cause weedy species to persist.



A swale formerly dominated by coyote brush and yellow bush lupine now supports a lush growth of native birdsfoot trefoil and sea thrift. European beachgrass was removed from the low ridge at right that formed when winter winds blew sand back towards the swale.

2005



2011



2014



This view is from the deflation plain looking east over the transgressive dunefield. In the foreground, the seasonal wetland has been cleared of duff, and willows have replaced the weedy species that were present. In the middle ground, hummocks of European beachgrass had formed in an area that would otherwise have been characterized by migrating, unvegetated dunes. Sparse native dune mat now grows on these lowered features. The forest visible in the background has been slowly disappearing over the past decades as the transgressive dunefield buries the forest.

2005



2011



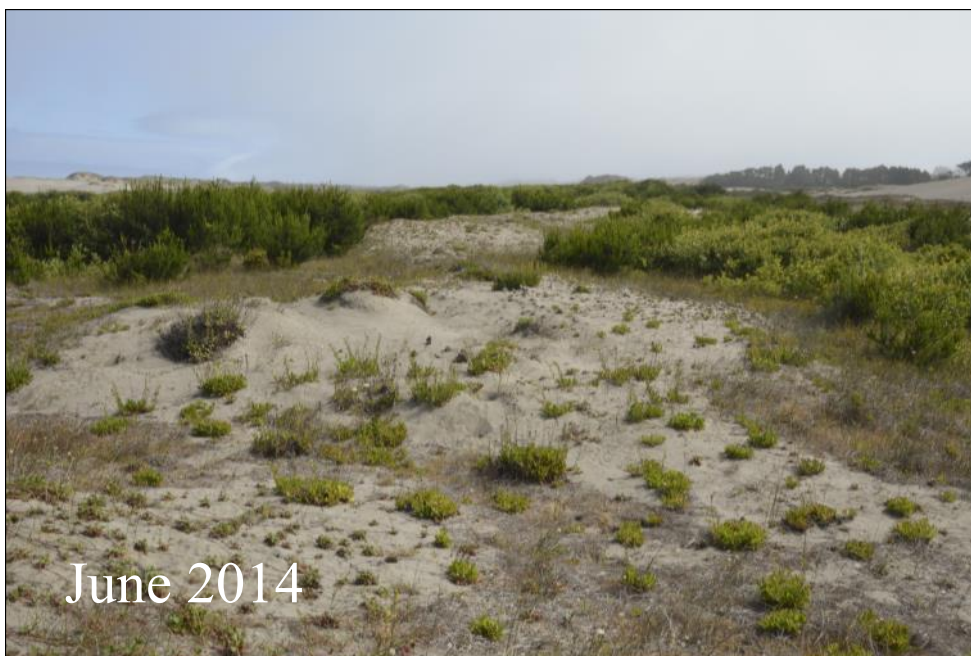
In addition to the European beachgrass in the foreground (top photo), the swale in the middle ground had dense yellow bush lupine, coyote brush and annual grasses. After removal of the shrubs and underlying duff, native rushes and sedges returned along with new growth of native willows and beach pine. Native dune goldenrod can be seen increasing in the foreground.



May 2004



July 2011



June 2014

Removal of European beachgrass, yellow bush lupine, pampas grass and other weeds restored this area to a mosaic of dune mat and seasonal wetlands. The narrow belt of wetland vegetation in the foreground decreased in area after the drought of 2013-14. Because they are formed when the water table intersects the dune surface, dune swales can shrink and expand depending on the amount and pattern of rainfall in a given year.

July 2004



July 2011



June 2014



These photographs illustrate how “process” is restored when invasive plants are removed. With the European beachgrass and yellow bush lupine removed from the intervening high areas, sand was able to move, causing an expansion of the wetlands in the deflation plain. Note the increase of willows in the wetland. The sedges in the 2014 photo are brown even though the photograph was taken a month earlier than in the other two years; a result of the drought in the preceding winter.



Photo Credits

2009: Patti Clifford and Kyle Wear
Other: Andrea Pickart